CLAIMS

We claim:

1. A process for deconvolving data collected by a device the point spread function response of which follows a Gaussian distribution, said process undertaken to accurately estimate actual parameters derivable from said data, comprising:

    forming at least one mathematical relationship having a first mathematical equivalent of said data on one side of an equality and a second mathematical equivalent of said parameters on the other side of said equality;

    selecting an order, *m*, of a Hermite function for modifying said at least one mathematical relationship;

    modifying said mathematical relationship to form at least one Hermite function therein,

    wherein forming said at least one Hermite function permits identification of at least one like item, having a coefficient, on each side of said equality, said coefficients associated with said actual parameters being unknown;

    developing at least one set of linear equations from said mathematical relationship that relate to said coefficient of each said at least one like items;

    solving said set of linear equations for said unknown coefficients,

    wherein solving said set of linear equations produces an exact solution to said convolution; and

    deconvolving said set of linear equations.

2. The process of claim 1 in which said mathematical relationship is of the form:

$$D(z) = \int p(z-x)I(x)dx$$

where:

D(z) = said data;

I(x) = expression involving said parameters; and

$p(x)$ = point spread function (PSF) representing response distribution of said device.

and

$$Y_m = \int_{-\infty}^{\infty} e^{-\frac{(z-x)^2}{2}} e^{-\frac{x^2}{2}} H_m(x)dx$$

where:

Y_m is said data represented at least partially as a Hermite function

said point spread function for said device is represented by $e^{-\frac{z-x^2}{2}}$,

said Hermite Function is represented by $e^{-\frac{x^2}{2}} H_m(x)$, and

$H_m(x)$ is a Hermite polynomial of order m.

3. The process of claim 1 initiating any conventional iterative deconvolution techniques to further refine said data,
wherein fewer iterations will be needed as compared to conventional methods of deconvolution because of the accurate starting point provided by said process.

4. A process for deconvolving output from detectors, the point spread function response of said detectors following a Gaussian distribution, said process undertaken to accurately estimate environments derivable from said output, comprising:

forming at least one mathematical relationship having a first mathematical equivalent of said output on one side of an equality and a second mathematical equivalent of said environments on the other side of said equality;

selecting an order, m, of a Hermite function for modifying said equality, wherein, said order also determines the number of terms for the representation of said environments;

modifying said equality to form at least one Hermite function within the equality,

wherein forming said Hermite function permits identification of at least one like item, having a coefficient, on each side of said equality;

developing at least one set of linear equations from said equality that relate to said coefficient of each said at least one like items; and

solving said set of linear equations for said coefficient of each said like item,

wherein solving said set of linear equations produces an exact solution to said convolution, in turn, permitting deconvolution using linear relationships.

5. The process of claim 4 in which said mathematical relationship is of the form:

$$D(z) = \int p(z-x)I(x)dx$$

where:

D(z)	=	said output;
I(x)	=	said environments; and
p(z-x)	=	a transformed function of the point spread function (PSF) representing response distribution of said device

6. The process of claim 4 initiating any conventional iterative nonlinear deconvolution technique to further refine said output,

wherein fewer iterations will be needed as compared to conventional methods of deconvolution because of the accurate starting point provided by said process.

7. A process yielding accurate representations of actual image data by deconvolving image data collected by optical detectors, the point spread function response of said detectors following a Gaussian distribution, comprising:

establishing a first mathematical relationship as a general optical convolution integral equating said actual image data to said collected image data;

selecting a Fourier-Hermite function;

employing a generating function for Hermite polynomials for expanding a Fourier-Hermite series of said Fourier-Hermite function to establish a linear mathematical relationship between said actual and said collected image data;

selecting an order, *m*, of said Fourier-Hermite polynomial,

wherein, *m* also determines the number of terms to be used for the representation of said images;

expanding said actual image data in said Fourier-Hermite form with unknown coefficients by employing a series of special transformations to convert the side of said mathematical relationship representing the actual image to a Fourier-Hermite series;

expanding said collected image data with known coefficients in said Fourier-Hermite form;

equating said known and unknown coefficients of like terms on each side of the mathematical relationship to relate the coefficients of said actual and said collected image data;

selecting an algorithm represented by a set of linear equations;

solving said linear equations exactly,

wherein using said process yields a form proportional to a Gaussian function times a power series that is defined with a finite number of terms and incorporates said unknown coefficients of said actual image data as presented in a Hermite function, and

wherein a solution in closed analytic form provides a satisfactory solution to said general definitional convolution integral without approximation; and

performing an analytic deconvolution of said convolution equation by inverting said linear equations,

wherein said analytic deconvolution yields a solution having acceptable error levels.

8. The process of claim 7 initiating any conventional iterative deconvolution techniques to further refine said accurate representations,

wherein fewer iterations will be needed as compared to conventional methods of deconvolution because of the accurate starting point provided by said process.